Alberta RESEARCH COUNCIL

LEGEND

RECENT

LACUSTRINE DEPOSITS

24 *Organic:* muskeg, swamp, sedge bog; deep and wet organic deposits in depressional areas

23 *Silt and clay:* mixture of silt and clay, sand along some beaches, some organic materials

EROSIONAL DEPOSITS

22 *Slump:* mixed glacial and bedrock materials; unstable slope

21 *Gully, creek valley:* thin colluvial cover over bedrock on valley slopes; thin alluvial materials along streams

ALLUVIAL DEPOSITS

20 *Alluvial fan:* bedded silt, sand, and clay; variable thickness, overlying glacial deposits

19 *Stream alluvium:* mainly sand along major rivers; sand, silt, and clay along small streams

AEOLIAN DEPOSITS

18 *Aeolian sand:* fine- to medium-grained sand in dune and sheet form; developed from glacial outwash and deltaic deposits; thickest in dunes, thin to nearly absent between dunes

17 *Loess:* silt to very fine sand; thin to very thin

PLEISTOCENE

GLACIOLACUSTRINE DEPOSITS

16 *Clay and silt:* bedded clay and silt with minor sand; generally thick; level topography

15 *Clay and silt:* containing pebbles and till-like layers; generally thin to very thin

14 *Silt:* massive to bedded silt with occasional pebbles; over five feet in thickness; level topography

13 *Sand and silt:* bedded sand and silt; generally thick; level topography with occasional small sand dunes

GLACIOFLUVIAL DEPOSITS

12 *Meltwater channel outwash:* outwash sand and gravel occurring along the bottoms and terraces of meltwater channels; generally thin; level surface topography

11 *Outwash sand:* medium- to coarse-grained sand with pebbles and small gravel lenses; variable in thickness; level to gently undulating topography

10 *Outwash sand and gravel:* medium- to coarse-grained sand and gravel with some large boulders; variable in thickness; topography undulating

9 *Kame, kame moraine:* sand and gravel to gravel; variable in thickness but generally thick; rolling topography

GLACIAL DEPOSITS

8 *Colluviated ground moraine:* till composed of sand, silt and clay with pebbles and boulders mantling colluviated steep slopes; partly bedded near surface; stable slope; generally thin

7 *Gipsy till-hummocky moraine:* predominantly sand derived from the Athabasca Sandstone; generally over forty feet thick; rolling topography

6 *Gipsy till-ground moraine:* predominantly sand derived from the Athabasca Sandstone; generally thin; undulating topography

5 *Kinosis till-hummocky moraine:* loam composition with numerous pebbles and boulders; generally thick; rolling topography

4 *Kinosis till-ground moraine:* loam composition with numerous pebbles and boulders; generally thin; undulating topography

3 *Horse River till-hummocky moraine:* silty clay composition; thick; rolling topography

2 *Horse River till-ground moraine:* silty clay composition; generally thin; undulating topography

DEVONIAN

1 *Methy Formation:* dolomite forming numerous outcrops

Geological boundary; defined, approximate, assumed

Abandoned beach

Meltwater channel

Meltwater channel scarp

Esker

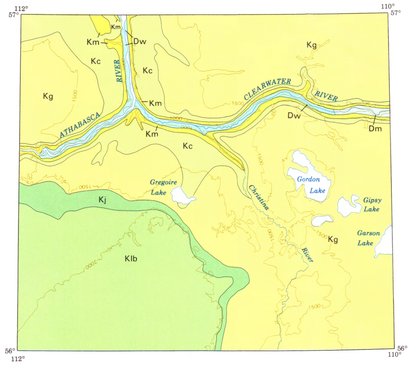
Glacial flutings and drumlins

Thin lacustrine deposit

Geology by L.A. Bayrock and T.H.F. Reimchen, 1973

BEDROCK GEOLOGY

From R. Green, 1972 — Scale 1:1,000,000



LEGEND

CRETACEOUS

Klb *Labiche Formation:* shale and silty shale; ironstone partings; silty fish-scale bearing beds

Kj *Joli Fou Formation:* dark grey shale; silty interbeds

Kg *Grand Rapids Formation:* quartzose and feldspathic sandstone; siltstone, silty shale; thin coal beds

Kc *Clearwater Formation:* silty shale; siltstone, sandstone

Km *McMurray Formation:* sandstone, siltstone, silty shale

DEVONIAN

Dw *Waterways Formation:* shale; argillaceous limestone

Dm *Middle Devonian:* dolomite, limestone

Geological boundary

Surface contour (contour interval 500 feet)

Base map provided by Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa; modified by Surveys Branch, Alberta Department of Highways and Transport

Cartographic editing by F.H. Smith and E.J. Seagel

Drawn by J.G. Maher

Published 1974

SCALE 1:250,000

Miles 5 0 5 10 15 20 Miles

Kilometers 5 0 5 10 15 20 25 30 Kilometers

LEGEND

River or stream

Intermittent river or stream

Lake

Intermittent lake

Road, hard surface, all weather

Railway

Township boundary

Section line

SURFICIAL GEOLOGY WATERWAYS

NTS 74D

MAP COLLECTION
UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA
CANADA

NTS 74 D Surficial
Alta. G-5:13:74D c.2

DESCRIPTIVE NOTES

BEDROCK GEOLOGY

The Devonian strata of limestone, dolomite, shale, and evaporites underlie the entire area. The dolomites and dolomitic limestones of the Middle Devonian Methy Formation and the interbedded shale and limestone of the Upper Devonian Waterways Formation outcrop along the Athabasca and Clearwater Rivers, causing rapids and waterfalls.

With the exception of the Labiche Formation, which is Upper and Lower Cretaceous, all other exposed bedrock formations are Lower Cretaceous.

The McMurray Formation, which consists of sandstone, siltstone, and shale, lies unconformably on the Devonian limestones of the Waterways Formation and is well exposed along rivers. In the western part of the map area the sandstone and shale are saturated with oil.

Tongues of shale in the upper part of the McMurray Formation are conformable with the overlying shales and sandstones of the Clearwater Formation.

The Grand Rapids Formation outcrops in the valleys and forms the first bedrock underlying the drift over much of the area.

The youngest rocks in the area, the Joli Fou and Labiche Formations, are marine shale.

SURFICIAL DEPOSITS AND LANDFORMS

Glacial Deposits

On the basis of topography, till plains are divided into *ground moraine* and *hummocky moraine* plains, with the former existing as shallow, nearly level plains mantling the bedrock, and the latter as till plains with considerable local relief. In thickness, ground moraine is from 5 to close to 40 feet, and hummocky moraine is from 40 up to and over 100 feet.

According to matrix composition, the tills of the area are divided into three main groups. *Gipsy till* is composed primarily of sand derived from the Athabasca Formation. The sand content exceeds 90 percent, and the balance is made up by silt, pebbles, and boulders. In many locations the Gipsy till surface has been reworked by wind, which has produced small sand dunes. On cursory examination Gipsy till could be called outwash sand, and the landforms which have developed on it kames, but the silt content substantiates the fact that it is till.

Kinosis till is till rich in gravel, having a matrix of a loam composition; that is, approximately equal proportions of sand, silt, and clay. It is present mainly in the Stony Mountain upland and north of the Clearwater River. On the Stony Mountain upland the till also contains a significant proportion of rounded quartzites derived from Tertiary gravel, signifying that Tertiary gravel may still underlie the upland.

Horse River till is a generally thin, clayey till containing fewer stones than the above two tills. It is present on the western flanks of Stony Mountain and north of the Athabasca River and underlies glaciolacustrine deposits over most of the area.

Glaciofluvial Deposits

Only one small *esker* is present in the area, located in the southeastern portion of the map area (Tp. 81, R. 2). The esker forms a sinuous ridge 20 feet high and 4 miles long, and consists of sand and gravel.

Kames are cone-shaped or rounded hills made of poorly sorted outwash sand and gravel which may serve as a source of aggregate for construction purposes. Two or more kames comprise a *kame moraine*. Generally the kames are steep sided and 50 feet or more in height.

Sand and gravel outwash plains are relatively rare in the area. The largest one is located in township 83, range 11. *Sand outwash plains* consist of medium- to coarse-grained sand. The sand averages about 10 feet in thickness. Many of the sand outwash plains are covered with a variable thickness of aeolian sand and sand dunes and consequently are mapped as aeolian deposit areas.

The largest and most important potential gravel supply in the area comes from *meltwater channel outwash*, which is variable in thickness. Usually channel outwash is covered with a thin overburden of sand or even silt, so that testing for aggregate should extend to at least 10 feet, in order to penetrate the overburden.

Glaciolacustrine Deposits

Glaciolacustrine deposits cover a very large portion of the map area. On the basis of grain size composition, they have been divided into three groups of deposits: *sand and silt, silt,* and *clay and silt.*

Lacustrine sand and silt deposits are generally present in the eastern half of the area. They vary in thickness from a few feet to over 10 feet. The thin deposits are outlined on the map by a brown line symbol. They are generally less than 5 feet thick and overlie till.

Lacustrine silt deposits are present only in the northwestern portion of the area and vary in thickness from a few feet to over 20 feet. Occasional pebbles occur in this deposit. The silt is nearly pure and consequently very unstable; it is therefore prone to flowage, frost heaving, and sliding.

Lacustrine clay and silt form the largest unit of lacustrine deposits in the area. In grain size they range from loam to silty clay. Pure clay is very rare. The shallow phase of the deposit (less than 5 feet) is also shown by a brown line symbol. In places, and particularly in the northwestern corner of the area, the clay and silt deposits also contain a significant proportion of pebbles and till-like lenses. These were formed primarily by drifting icebergs in glacial lakes. Generally, the pebbly phase is thin to very thin and overlies till directly. Occasionally the pebbles may be so numerous that they give the lacustrine deposits a till-like appearance.

Aeolian Deposits

Loess, which is silt deposited by wind, is found only on the northern shore of Gordon Lake. It is massive and varies from silt to very fine sand in texture.

Aeolian sand occurs as dunes or as sheet sand. The dunes show effective wind direction from the southeast to east. Generally, the dune sand is medium-grained, massive, and very clean. In many locations where surface vegetation on the dunes has been stripped, blowouts are present. The dunes vary from 10 to over 30 feet in height. Between the dunes, aeolian sand sheet deposits of variable thickness are present; generally they are very thin, ranging from about 2 to 5 feet thick.

Alluvial Deposits

Stream alluvium is generally very thin in the area as most of the streams are still incising into bedrock. Small streams have alluvium made of sand, silt, and clay. There is often a lag gravel layer derived from the underlying till. The large rivers, on the other hand, have alluvium made of sand. Gravel-sized material is rare, and if present, it is of very local origin.

Alluvial fans are present mainly at the foot of Stony Mountain, Muskeg Mountain, and in the Clearwater River valley along the base of some steep banks. The material making up the alluvial fans is of sand to silty clay texture, generally thin, and bedded on a small scale.

Erosional Features

Gullies and creek valleys in the area have very steep slopes, and most of the glacial deposits are relatively thin. Thin colluvium mantles the slope, obscuring bedrock outcrops in most areas except where active erosion is taking place or where bedrock ledges protrude to the surface.

Slump is the movement of massive blocks of materials on steep slopes. Generally the slump areas consist of a mixture of glacial and bedrock materials. The areas outlined as slump on the map are extremely unstable, and new movements of materials downslope can be expected.

Recent Lacustrine Deposits

Recent lacustrine deposits exposed above lake levels are rare, located around some lakes in the eastern portion of the map area. Generally, they consist of *silt and clay* with organic material. Where former beaches were present, sand is encountered.

Organic deposits are present as swamps, muskegs, and peat bog and cover a very large portion of the map area. Generally they are very thin, ranging from 1 to 3 feet in depth. Deep bogs are relatively rare and are of the wet-sedge bog type. Only the deep sedge bogs have been delineated.

EXPLANATORY NOTE

Map users may note nomenclatoral discrepancies between rock units on the Bitumount and Waterways map sheets. The discrepancies are explicable as follows. Gipsy till is composed essentially of sand with pebbles and boulders derived from the Athabasca Formation. In certain locations, specifically in the northeastern corner of the Waterways area (NTS 74D), the Gipsy till is so devoid of fines that it has been subject to aeolian action and supports occasional sand dunes. In the Bitumount area (NTS 74E) Gipsy till was interpreted as outwash sand and gravel (legend unit 7), and as outwash sand and gravel overridden by glacier (legend unit 6). As new information became available, it was realized that these units actually are a till (Gipsy till) which in grain size composition approximates outwash.